

Construction of first atomic clock - 1955

➤ Development

- In **1945**, **Isidor Rabi** first suggested that atomic beam magnetic resonance can be used as a resonator of the clock.
- First atomic clock, based on a certain transition of the caesium-133 atom, was built by Louis Essen in 1955 at the National Physical Laboratory in the UK
- Since the beginning of development, atomic clocks have been based on the hyperfine transitions in hydrogen-1, caesium-133, and rubidium-87.

➤ Different Standards

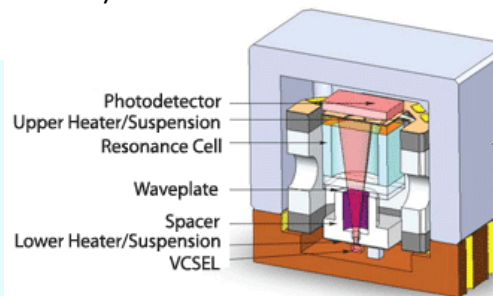
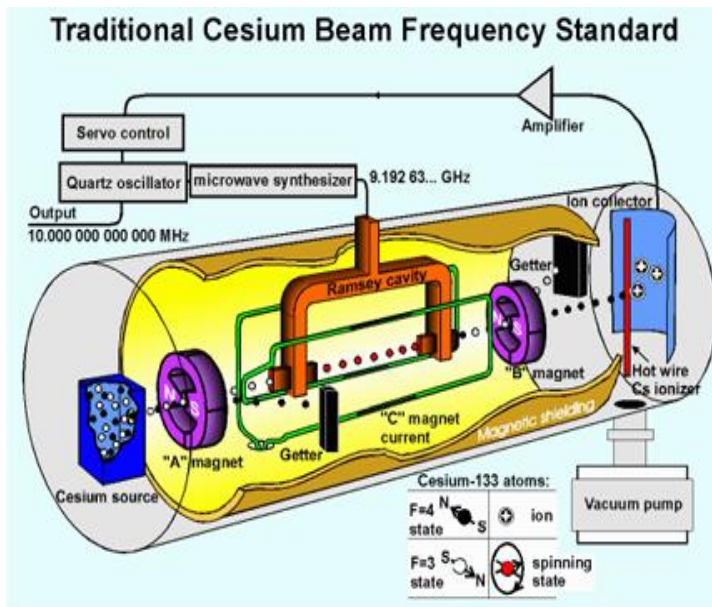
- **Atomic Beam Standard**
- **Atomic gas cell standard** (Very low cost)
- **Active maser standard**
- **Fountain standard** (often use as national standard)
- **Ion trap standard** (more accuracy)

➤ Theory

- Using the microwave generated from hyperfine transitions of atoms as frequency standard.
- The atoms are excited to a common state using optical pumping.
- Then applied RF field is swept over the hyperfine spectrum, the atoms will absorb the pumping light, and a photodetector provides the response.

➤ Application

- Global Positioning System (GPS)
- Interferometry in radioastronomy
- Time signal radio transmitters
- Experimental testing of Relativity theory. (Hafele–Keating "flying clock" experiment in 1971)



Chip Scale Atomic Clock

